

INTERVIEW SUMMARY

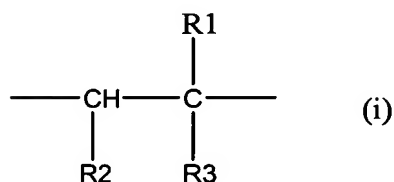
Applicants wish to thank Examiner Pezutto for the helpful and courteous discussion with Applicants' Representative on July 26, 2005. During this discussion it was noted that GB 1066715, Barr et al, Le Khac et al, JP-117334 and Harris et al fail to disclose or suggest an optical compensation film having negative birefringence and a relationship of three-dimensional refractive indexes of $n_z \geq n_y > n_x$ as claimed in Claim 1, or $n_z > n_y \geq n_x$ or $n_z > n_x \geq n_y$ as claimed in Claim 5.

REMARKS

Applicants respectfully request reconsideration of the application, as amended, in view of the following remarks.

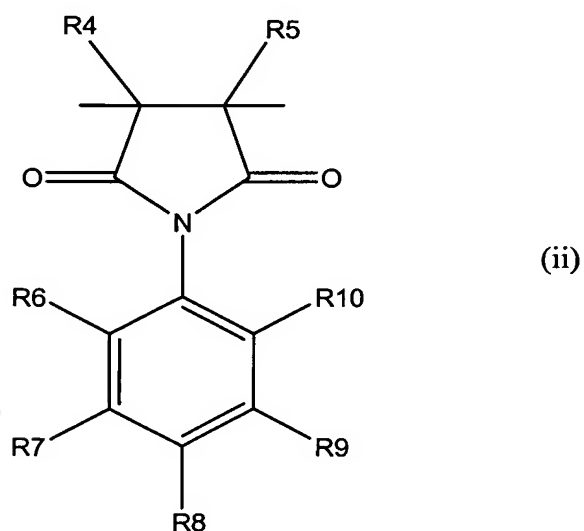
The present invention as set forth in **amended Claim 1** relates to an optical compensating film, comprising:

a copolymer consisting essentially of an olefin residue unit represented by the following formula (i):



and

an N-phenyl-substituted maleimide residue unit represented by the following formula (ii):



the copolymer having a weight average molecular weight, as reduced into standard polystyrene, of from 5×10^3 to 5×10^6 ,

the optical compensating film being obtained by uniaxially stretch molding the copolymer,

the optical compensating film having a relationship of three-dimensional refractive indexes of $n_z \geq n_y > n_x$ in the case where the stretching direction is an x-axis within the film plane, the perpendicular direction to the x-axis within the film plane is a y-axis, and the vertical direction outside the film plane is a z-axis, n_x stands for a refractive index in the x-axis direction, n_y stands for a refractive index in the y-axis direction, and n_z stands for a refractive index in the z-axis direction, and

the optical compensating film exhibiting negative birefringence.

Amended Claim 5 relates to an optical compensating film, comprising:

a copolymer as above,

the optical compensating film being obtained by biaxially stretch molding the copolymer,

the optical compensating film having a relationship of three-dimensional refractive indexes of $n_z > n_y \geq n_x$ or $n_z > n_x \geq n_y$ in the case where the biaxial stretching directions are an x-axis within the film plane and a y-axis within the film plane, and the vertical direction outside the film plane is a z-axis, n_x stands for a refractive index in the x-axis direction, n_y stands for a refractive index in the y-axis direction, and n_z stands for a refractive index in the z-axis direction, and

the optical compensating film exhibiting negative birefringence.

In contrast, GB 1066715, Barr et al, Le Khac et al, JP-117334 and Harris et al fail to disclose or suggest an optical compensation film having negative birefringence and a

relationship of three-dimensional refractive indexes of $n_z \geq n_y > n_x$ as claimed in Claim 1, or $n_z > n_y \geq n_x$ or $n_z > n_x \geq n_y$ as claimed in Claim 5.

In order to have a certain birefringence or a three-dimensional relationship of refractive indexes in a film, one must have optical anisotropy, meaning that the properties of a film are different in different directions. See the attached print-out from the web-site: www.wordreference.com. Isotropic films (as opposed to anisotropic films) have only one refractive index, the properties are the same no matter what the direction in the film.

In order to create a difference of a refractive index or birefringence depending on the direction in the film, the films must be prepared in a certain way. Accordingly, Claims 1 and 5, require that the films be obtained by uniaxially stretch molding or biaxially stretch molding, respectively.

GB 1066715 (GB 1066715, page 1, left column, lines 9-12 and 28-37) and Barr et al (Barr et al, col. 1, lines 28-34 and col. 4, line 14, lines 26-29) disclose an olefin-N-ortho-substituted phenyl maleimide copolymer, and a transparent film obtained by solution casting the copolymer. There is no disclosure of a method which results in a material having a negative birefringence. There is no uniaxially stretch molding or biaxially stretch molding as claimed in Claims 1 and 5, respectively. None of the above references discloses such steps. Thus, the films of GB 1066715 and Barr et al do not exhibit a negative birefringence or a relationship of three-dimensional refractive indexes of $n_z \geq n_y > n_x$, or $n_z > n_y \geq n_x$ or $n_z > n_x \geq n_y$. As a result, the films of GB 1066715 and Barr et al are not considered to be optical compensating films as claimed.

Le Khac et al disclose a polymer composition containing of a copolymer having recurrent units of a C_2 to C_4 α -olefin and recurrent units of an N-aryl substituted maleimide and an acrylonitrile copolymer (Le Khac et al, abstract) and a test piece comprising the composition. However, such a test piece is merely molded as a test piece. There is no

disclosure of a method which results in a material having a negative birefringence. There is no uniaxially stretch molding or biaxially stretch molding as claimed in Claims 1 and 5, respectively. Thus, the test piece of Le-Khac does not exhibit a negative birefringence or a relationship of three-dimensional refractive indexes of $n_z \geq n_y > n_x$, or $n_z > n_y \geq n_x$ or $n_z > n_x \geq n_y$. As a result, the films of Le-Khac are not considered to be optical compensating films as claimed.

JP-117334 discloses an **olefin/ N-phenyl substituted maleimide/ N-alkyl substituted maleimide copolymer** and an optical material comprising the copolymer. The optical material exhibits **low** birefringence (JP-117334, abstract). However, **low** birefringence is **not negative** birefringence. Further, JP-117334 describes that negative birefringence is controlled by the stereo structure of the benzene ring in the maleimide unit. This description refers only to the **N-phenyl substituted maleimide unit itself** or to **N-phenyl substituted maleimide homopolymer**. However, there is no disclosure or suggestion that the copolymer has negative birefringence.

Further, the optical material of the present invention comprises a **copolymer** consisting essentially of a N-substituted phenyl maleimide compound and an olefin. This is not a **terpolymer** having a N-alkyl substituted maleimide unit as set forth in JP-117334.

Further, there is no disclosure of a method which results in a material having a negative birefringence. There is no uniaxially stretch molding or biaxially stretch molding as claimed in Claims 1 and 5, respectively. Thus, the material of JP-117334 does not exhibit a negative birefringence or a relationship of three-dimensional refractive indexes of $n_z \geq n_y > n_x$, or $n_z > n_y \geq n_x$ or $n_z > n_x \geq n_y$. As a result, the material of JP-117334 is not considered to be an optical compensating film as claimed.

Harris et al disclose a **polyimide film** having negative birefringence and a method for controlling negative birefringence in the polyimide film (Harris et al, abstract).

The polyimide disclosed in Harris et al. is an aromatic polyimide which differs from the binary copolymer consisting essentially of an N-ortho substituted phenyl maleimide and an olefin, constituting the optical compensating film of the present invention. Harris et al. does not contain any disclosure or suggestion of an optical compensating film as claimed exhibiting a negative birefringence and also having a relationship of three-dimensional refractive indexes of $n_z \geq n_y > n_x$, or $n_z > n_y \geq n_x$ or $n_z > n_x \geq n_y$. As such Harris et al fails to cure the defects of JP-117334.

In addition, Applicants have performed the following experiments. A signed Rule 132 Declaration will be filed as soon as it becomes available. The results show in Experiment 1 that a sheet obtained by compression molding N-(2-methylphenyl)maleimide-isobutene copolymer does not exhibit a negative birefringence, and it is difficult to measure a retardation amount. In Experiment 2 is shown that a sheet obtained by compression molding N-phenylmaleimide-isobutene copolymer does not exhibit a positive birefringence, and it is difficult to measure a retardation amount. The result of Experiment 3 was that a sheet obtained by compression molding a terpolymer containing N-aryl substituted maleimide, N-alkyl substituted maleimide and olefin, as described in JP 05-117334 cannot be judged in terms of positive and negative birefringence, and it is difficult to measure a retardation amount. The result of Experiment 4 was that a stretched film obtained showed a positive birefringence. Further, the retardation amount was very small, which was very small as an optical compensating function. Therefore, such films cannot be expected to have an optical compensating function.

The results of the experiments show that the optical compensating function (birefringence property) is not exhibited to only due a molecular structure of a material used.

The **details of the experiments** are as follows.

The following comparative experiments were conducted to clarify the difference in exhibition of optical compensating function between the cited references and the claimed invention.

EXPERIMENT 1

In a one-liter autoclave were charged 400 ml of toluene as a polymerization solvent, 0.001 moles of perbutyl neodecanoate as a polymerization initiator, 0.42 moles of N-(2-methylphenyl)maleimide, and 4.05 moles of isobutene, and the mixture was subjected to polymerization reaction under a polymerization condition at a polymerization temperature of 60°C for a polymerization time of 5 hours, to obtain N-(2-methylphenyl)maleimide-isobutene alternating copolymer. The thus obtained N-(2-methylphenyl)maleimide-isobutene alternating copolymer had a weight average molecular weight (Mw) (as reduced into standard polystyrene) of 160,000 and a molecular weight distribution (Mw/Mn), which is expressed by $[(\text{weight average molecular weight (Mw)})/(\text{number average molecular weight (Mn)})]$, of 2.7.

The N-(2-methylphenyl)maleimide-isobutene alternating copolymer obtained was molded using 50 tons compression molding machine (manufactured by Shinto Co.) at 270°C to obtain a sheet of 50 mm x 50 mm x 1 mm.

The sheet obtained had a light transmittance of 89%, a haze of 0.6%, a refractive index of 1.57, an Abbe number of 37, and a glass transition temperature (Tg) of 206°C.

As a result of judgment of positive and negative birefringence of this sheet in the same manner as described in the specification of the present application, it was found that positive birefringence portions and negative birefringence portions were intermixed depending on the measured position on the sheet, and it was difficult to judge.

It was also difficult to measure the retardation amount, and the sheet could not be found to function as an optical compensating material.

EXPERIMENT 2

In a one-liter autoclave were charged 400 ml of toluene as a polymerization solvent, 0.001 moles of perbutyl neodecanoate as a polymerization initiator, 0.42 moles of N-phenylmaleimide, and 4.05 moles of isobutene, and the mixture was subjected to polymerization reaction under a polymerization condition at a polymerization temperature of 60°C for a polymerization time of 5 hours, to obtain N-phenylmaleimide-isobutene copolymer. The thus obtained copolymer had a weight average molecular weight (M_w) of 162,000 and a molecular weight distribution (M_w/M_n) of 2.6.

The N-phenylmaleimide-isobutene copolymer obtained was molded using 50 tons compression molding machine (manufactured by Shinto Co.) at 270°C to obtain a sheet of 50 mm x 50 mm x 1 mm.

The sheet obtained had a light transmittance of 89%, a haze of 0.6%, a refractive index of 1.55, an Abbe number of 42, and a glass transition temperature (T_g) of 192°C.

As a result of judgment of positive and negative birefringence of this sheet in the same manner as described in the specification of the present application, it was found that positive birefringence portions and negative birefringence portions were intermixed depending on the measured position on the sheet, and it was difficult to judge.

It was also difficult to measure the retardation amount, and the sheet could not be found to function as an optical compensating material.

EXPERIMENT 3

In a one-liter autoclave were charged 400 ml of toluene as a polymerization solvent, 0.001 moles of perbutyl neodecanoate as a polymerization initiator, 0.56 moles of N-(2-methylphenyl)maleimide, 0.14 moles of N-methylmaleimide, and 4.05 moles of isobutene, and the mixture was subjected to polymerization reaction under a polymerization condition at

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a polymerization temperature of 60°C for a polymerization time of 5 hours, to obtain N-(2-methylphenyl)maleimide-isobutene copolymer. The thus obtained copolymer had a weight average molecular weight (Mw) of 20,000 and a molecular weight distribution (Mw/Mn) of 2.7.

A ratio of N-(2-methylphenyl)maleimide unit to N-methylphenylmaleimide in the copolymer was 4/1 as a result of H-NMR measurement and elemental analysis, and the amount of the total maleimide units was 50 mol%.

The N-(2-methylphenyl)maleimide-N-methylmaleimide-isobutene copolymer obtained was molded using 50 tons compression molding machine (manufactured by Shinto Co.) at 270°C to obtain a sheet of 50 mm x 50 mm x 1 mm.

The sheet obtained had a light transmittance of 90%, a haze of 0.5%, a refractive index of 1.55, an Abbe number of 37, and a glass transition temperature (Tg) of 170°C.

As a result of judgment of positive and negative birefringence of this sheet in the same manner as described in the specification of the present application, positive birefringence was not confirmed in the sheet, and it was difficult to judge.

It was also difficult to measure the retardation amount, and the sheet did not have the optical properties to function as an optical compensating material.

EXPERIMENT 4

A solution of 25% by weight of the N-(2-methylphenyl)maleimide-N-methylmaleimide-isobutene copolymer obtained in Experiment 3 above and 75% by weight of methylene chloride was prepared and cast on a polyethylene terephthalate film. An N-(2-methylphenyl)maleimide-N-methylmaleimide-isobutene copolymer film formed after the methylene chloride had been volatilized and solidified from the solution was peeled. The film after peeling was dried at 100°C for 4 hours and further dried while raising the temperature

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from 120°C to 160°C with an interval of 10°C for one hour at the respective temperature.

Thereafter, the resulting film was dried in vacuo at 180°C for 4 hours using a vacuum dryer, to obtain a film having a thickness of about 100 μm . The film was cut into a piece having a size of 5 cm x 5 cm, which was then stretched by +50% upon free-width uniaxial stretching under a condition at a temperature of 180°C and at a rate of stretching of 15 mm/min using a biaxial stretching machine (manufactured by Imoto Machinery Co., Ltd.), to obtain a stretched film.

The obtained stretched film showed positive birefringence, and had a retardation amount, $R_e = (n_x - n_y)d$, of +15 nm per 100 μm of the stretched film thickness. Here, d stands for a film thickness. The three-dimensional refractive indexes were $n_x=1.55385$, $n_y=1.55370$, and $n_z=1.55370$, thus $n_x > n_y = n_z$.

The result of Experiment 1 was as follows. A sheet obtained by compression molding N-(2-methylphenyl)maleimide-isobutene copolymer used in Example 1 of the present application does not exhibit a negative birefringence, and it is difficult to measure a retardation amount. It is therefore apparent that an optical compensating function is not exhibited only due to a material (molecular structure).

The result of Experiment 2 was as follows. A sheet obtained by compression molding N-phenylmaleimide-isobutene copolymer used in Comparative Example 1 of the present application does not exhibit a positive birefringence, and it is difficult to measure a retardation amount. Similar to Experiment 1, it is apparent that an optical compensating function is not exhibited to only due a material (molecular structure).

The result of Experiment 3 was as follows. A sheet obtained by compression molding a terpolymer containing N-aryl substituted maleimide, N-alkyl substituted maleimide and olefin, as described in JP 05-117334 cannot be judged in terms of positive and negative birefringence, and it is difficult to measure a retardation amount. Similar to Experiments 1

and 2, it is apparent that an optical compensating function is not exhibited to only due a material (molecular structure).

The result of Experiment 4 was as follows. The stretched film obtained showed a positive birefringence. Further, the retardation amount was very small, which was very small as an optical compensating function. Therefore, such a film cannot be expected to have an optical compensating function.

The results of the above Experiments clearly show that the optical compensating function (birefringence property) is not exhibited to only due a molecular structure of a material used.

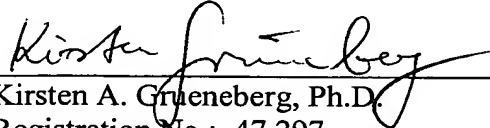
Therefore, the rejection of Claims 1-6 and 19 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over GB 1066715 or Barr et al (U.S. 3,352,832) or Le-Khac (U.S. 4,605,700) and the rejection of Claims 1-6 and 19 under 35 U.S.C. § 103(a) as being unpatentable over JP-117334 in view of Harris et al (U.S. 5,344,916) are believed to be unsustainable as the present invention is neither anticipated nor obvious and withdrawal of these rejections is respectfully requested.

This application presents allowable subject matter, and the Examiner is kindly requested to pass it to issue. Should the Examiner have any questions regarding the claims or otherwise wish to discuss this case, he is kindly invited to contact Applicants' below-signed representative, who would be happy to provide any assistance deemed necessary in speeding this application to allowance.

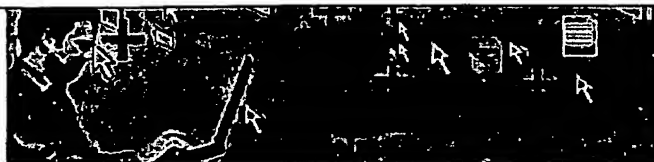
Respectfully submitted,

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anisotropy

A noun

1 anisotropy

*the property of being anisotropic;
having a different value when
measured in different directions*

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